Radio Shack®

# Service Manual

26-1269

# TRS-80®

## PTC-64

## Printer Controller

### Catalog Number 26-1269

CUSTOM MANUFACTURED FOR RADIO SHACK, A DIVISION OF TANDY CORPORATION

TRS-80® PTC-64 Printer Controller Service Manual

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## 1/ INTRODUCTION

The TRS-80 PTC-64 Printer Controller works as an interface between the computer and the printout device. It plugs into the parallel printer port of any TRS-80 microcomputer. The PTC-64 accepts data from the computer at computer transfer speed, stores that information in its internal memory, and then transfers that information to the printer at printer speed. This frees the computer to do other tasks during the printing operation.

As long as the unit is not turned off, the information will be stored until printed. There is a limit of 62K of memory since the unit itself requires 2K of memory for control operations. Special features include a piezo buzzer that can be activated by the computer, and a PAUSE control to cease printing without causing a printer fault. The PCT-64 allows multiple copies of the text and the translation of ASCII data into bit graphics information. For a complete description of these controls, see the Owner's Manual.

Figure 1-1 shows the typical interconnection for the PTC-64 when used with a parallel-type printer. Cable numbers are noted for standard Radio Shack printers. Cable length between the computer and the PTC-64 and between the PTC-64 and the printer should not exceed 12 feet.

When operating the unit, position it on a level surface, free from vibration. Turn off all power when interconnecting the computer, the PTC-64, and the printer. The attaching cables will plug into the PTC-64 only one way. If they are difficult to insert, turn the plug over and try again.

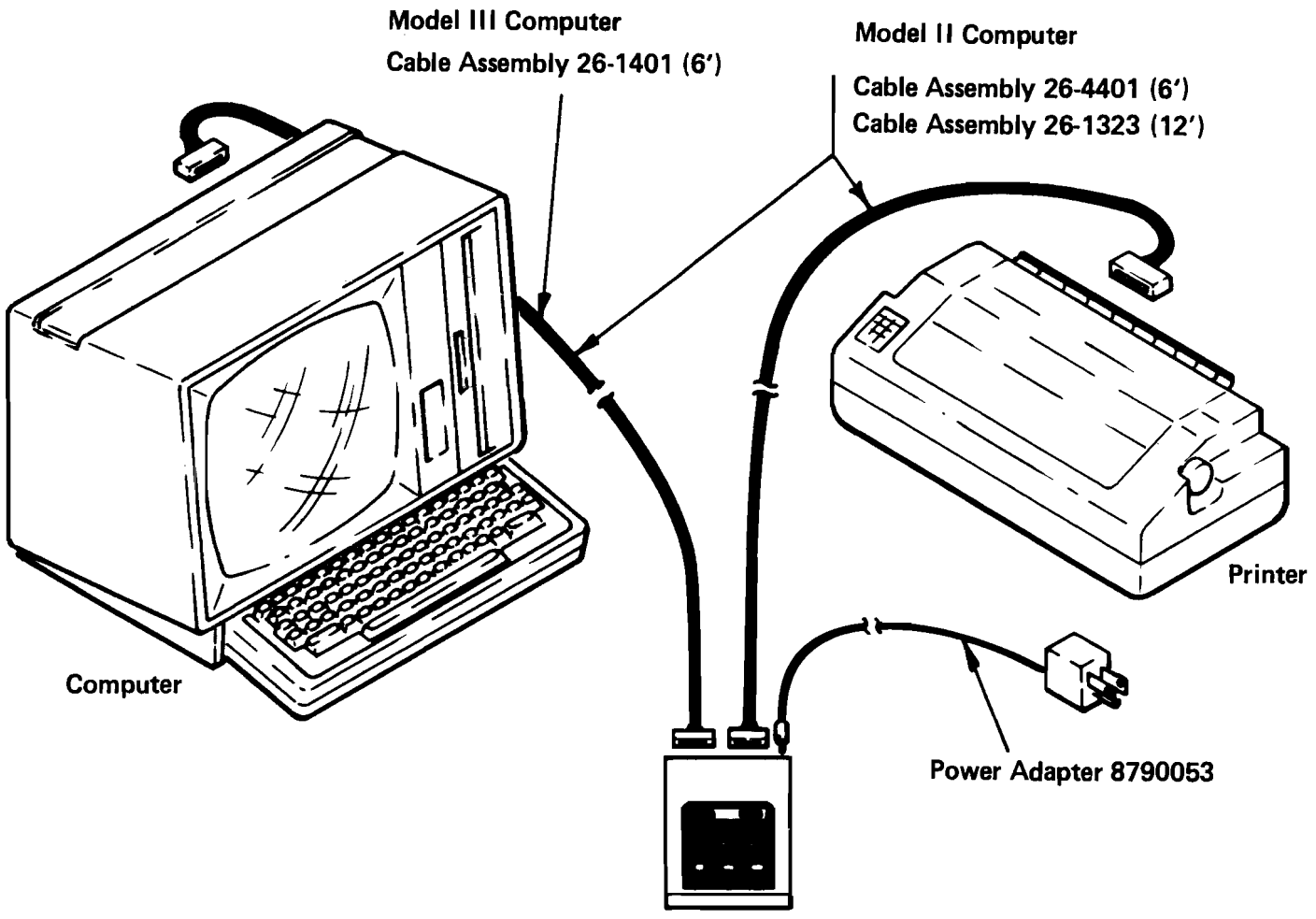



Figure 1-1. Typical PTC-64 Interconnection

## 2/ SPECIFICATIONS

### 2.1 Mechanical

Physical Size:
Width - 6.5" (16.5 cm)
Depth - 7.5" (19.05 cm)
Height - 2.375" (6.03 cm)

Weight - 1.1 pounds (400 grams)

Input Connections
Power - Miniature phone jack from AC Adapter
From Computer - 36-pin, latch-type connector
To Printer - 34-pin, dual-row connector

Front Panel Switches

CLEAR Key - marks buffer memory, aborts printing in progress, and clears any stored data from the buffer.

COPY Key - initiates printing from mark provided by CLEAR key.

PAUSE Key - temporarily interrupts printing, resumes when key is pressed second time.

### 2.2 Electrical

External Input - 11 VAC @ 600 mA from 115V AC Adapter (Radio Shack P/N 8790053)

### 2.3 Environmental

Operating Temperature - 41° F to 104° F (5° C to 40° C)
Humidity - 20 to 80% RH (non-condensing)
Storage Temperature - 32° F to 142° F (0° C to 61° C)

## 3/ DISASSEMBLY/ASSEMBLY

Refer to the Exploded View, Section 7.

The mechanical assembly of the PTC-64 consists of a top and bottom cover with the PCB sandwiched between. The PCB is connected to the top cover key pad by a ribbon cable that plugs into J1 on the PCB. The computer and printer connections are made to J2 and J3. These connectors are at the rear of the assembly and are attached directly to the PCB.

To disassemble the unit, follow the steps below.

1. Turn off all power to the PTC-64, the computer and the printer.

2. Disconnect all cabling to the PTC-64 (computer cable, printer cable, AC input from adapter).

3. Turn the unit upside down and remove the four screws which connect the top and bottom covers.

4. Carefully turn the unit rightside up. Lift the top cover from the front until the ribbon cable to J1 is accessible.

5. Unplug the ribbon cable from the PCB.

6. Remove two screws from the PCB corners and two screws from the J3 connection.

7. Remove the PCB from the bosses on the bottom cover.

8. Remove the RF shield from the bottom of the PCB.

Reassemble in the reverse order of disassembly. Be sure the RF shield is fastened to the bottom of the PCB. Seat the PCB on the bosses of the bottom cover and secure it with four screws. Exercise care when reattaching the ribbon cable. Be sure that good contact is made and that the cable is properly seated in the connector prior to securing the top and bottom covers.

# 4/ THEORY OF OPERATION

## 4.1 Power Supply

The power supply for the PTC-64 consists of an AC adapter (11 VAC @ 600 mA), four diodes (CR2-CR5), two bulk capacitors (C27-C28), and a 7805 +5 Volt regulator (VR1). The AC adapter is plugged into J4 at the rear of the PTC-64. The AC is then full-wave rectified using CR2-CR5. The result, approximately 7 VDC, is presented to the input of VR1. The voltage is regulated by VR1 and filtered (to reduce the ripple voltage) by C28, a 3300µF capacitor. VR1 supplies +5 VDC to the circuits on the internal PCB.

## 4.2 Processor and Support Logic

This circuit uses a Z80A microprocessor operating at 2 MHz. There is 64K of RAM on this board, but under normal conditions only 62K of RAM can be accessed. This exception will be covered in Paragraph 4.3, Address Decoding.

A TTL oscillator is constructed using an 8 MHz series-resonant crystal (Y1), a 74LS00 (U2), miscellaneous resistors (R3-R6), and a capacitor (C9). The output of this circuit goes through two D-type flop-flops (U3) that provide a divide-by-4 function. The resultant 2 MHz output is used as the processor clock (U11 pin 6). The basic 8 MHz signal is used for memory timing.

The Z80A RESET* (pin 26) is connected to a power-on reset circuit which is comprised of diode (CR1), resistor (R23), and capacitor (C17). This circuit is the only means of resetting the Z80 microprocessor.

## 4.3 Address Decoding

### 4.3.1 ROM Decoding

This device uses a 2K x 8 ROM for the monitor program. This ROM (U10) is memory-mapped to addresses 000-07FF (Hex) using a 74LS260, 5-input NOR (U8). Under normal conditions, this

disables the first 2K of available RAM, leaving approximately 62K of RAM for buffer storage. Under certain conditions, described in the Owner's Manual, this ROM may be disabled, allowing a special driver program to control the Z80A and access the full 64K of RAM. A 74LS74 (U14) is used to latch the ROM in or out. Pin 9 of U14 is the output of this latch. If this pin is low (0 V), the ROM is enabled; if it is high (greater than 3 V), the ROM is disabled. If the ROM is disabled, there are only two ways to turn it back on. One is to reset the Z80A (power down), and the other is to turn it back on via software. To turn the ROM on using software, execute an OUT to port 2 with bit 0 reset then jump to address 00 hex.

### 4.3.2 RAM Decoding and Timing

The PTC-64 uses eight 64K x 1 bit RAMs (U15, 16, 21, 22, 26, 27, 29, 30). These are dynamic RAMs which require refreshing 128 rows every 2 milliseconds. This refreshing is accomplished via the RAS* signal (Row Address Strobe), and the RFRSH* signal on the Z80. The Z80 has a built-in refresh counter that performs this function at the end of every instruction fetch. The RAS* signal to the RAMs is generated every time MEMRQ* (from U11) is active and the ROM is not being addressed. A 74LS175 (U6) is used as a shift register to provide the MUX signal to the address multiplexers (U9, U13) and the CAS* (Column Address Strobe) to the RAMs. It is clocked using the 8 MHz clock signal previously discussed. The Q3* output of U6 is ANDed with WR* and RD* to disable CAS* at the end of a memory access.

### 4.3.3 Processor Interrupts

Pressing a key on the front panel causes interrupts, while NMIs are caused by the computer generating a byte of data. If a user program is downloaded, interrupts may be disabled, but NMI must be supported.

4.3.4 Port Assignments

| Address | Read | Write |
|---|---|---|
| 0 | Computer Data | Printer Data |
| 1 | Keyboard & Printer Status | Computer Status |
| 2 | Clear Pending Interrupt | ROM Enable |

Note: Only the two least significant bits are used for port decoding. Therefore, an OUT instruction to port 0, 4, 8, 12, 16, 20 etc. will access the Printer Data Port.

4.3.5 Bit Assignments

Printer Status

| | | |
|---|---|---|
| Bit 7 | | CLEAR key from keyboard |
| Bit 6 | | COPY key from keyboard |
| Bit 5 | | PAUSE key from keyboard |
| Bit 4 | | Busy* from printer |
| Bit 3 | | Fault* from printer |
| Bit 2 | # | Busy from printer |
| Bit 1 | # | Paper empty from printer |
| Bit 0 | | Ack* from printer |

Computer Status

| | | |
|---|---|---|
| Bit 7 | @ | Status LED |
| Bit 6 | @ | Status LED |
| Bit 5 | | Piezo Buzzer |
| Bit 4 | # | Fault* to computer and LED |
| Bit 3 | # | Busy* to computer |
| Bit 2 | | Busy to computer |
| Bit 1 | # | Ack* to computer |
| Bit 0 | | Paper empty to computer |

Special Notes:
# - These signals are active low (0 = active)
@ - See Status LED operation description for details

4.3.6 Status LED Operation

The Status LED (DS2) is a tri-color LED that changes color according to the bias of the voltage applied. When a DC voltage is connected to the LED, the green light is turned on. When a reverse-biased DC voltage is connected, the red light is turned on.

When an AC signal is connected, both lights are turned on which causes a yellow light. Using LS00 NAND gates (U18) and LS38 drivers (U24), two port bits are decoded which allow use of all three colors and the off state. These two port bits are the most significant bits of the Computer Status port. On the schematic diagram, they are labeled LEDACT and LEDFUL. The possible combinations are listed below.

| Bit 7 | Bit 6 | State |
|---|---|---|
| 0 | 0 | Buffer Status LED is off |
| 0 | 1 | Buffer Status LED is red |
| 1 | 0 | Buffer Status LED is green |
| 1 | 1 | Buffer Status LED is yellow |

When both bits are a logic 1, the processor signal MEMRQ* is used to generate an alternating DC signal to the LED. This alternates between red and green and generates a yellow appearance.

### 4.3.7 Printer Data Port

The Printer Data port is comprised of a 74LS374 8-bit latch (U7) and a 74LS123 one-shot multivibrator (U23). When an OUT instruction to port 0 is executed, the one-shot is automatically triggered with the rising edge of the IORQ* signal. The duration is approximately 2.0 microseconds. If the duration is less than 1.5 microseconds, the printer will not operate reliably.

### 4.3.8 Computer Data Port

The Computer Data port (J3) uses a 74LS244 (U20) as a buffer for data transmitted to the computer. This is not a latch, so data must be read immediately after CSTROBE* goes low. When CSTROBE* goes low, it triggers an NMI to the Z80. This interrupts anything that is in progress and executes a special routine to get a byte of data. CSTROBE* also triggers a one-shot to generate a BUSY back to the computer. For more information on this one-shot, see Paragraph 4.3.10, Busy Generation.

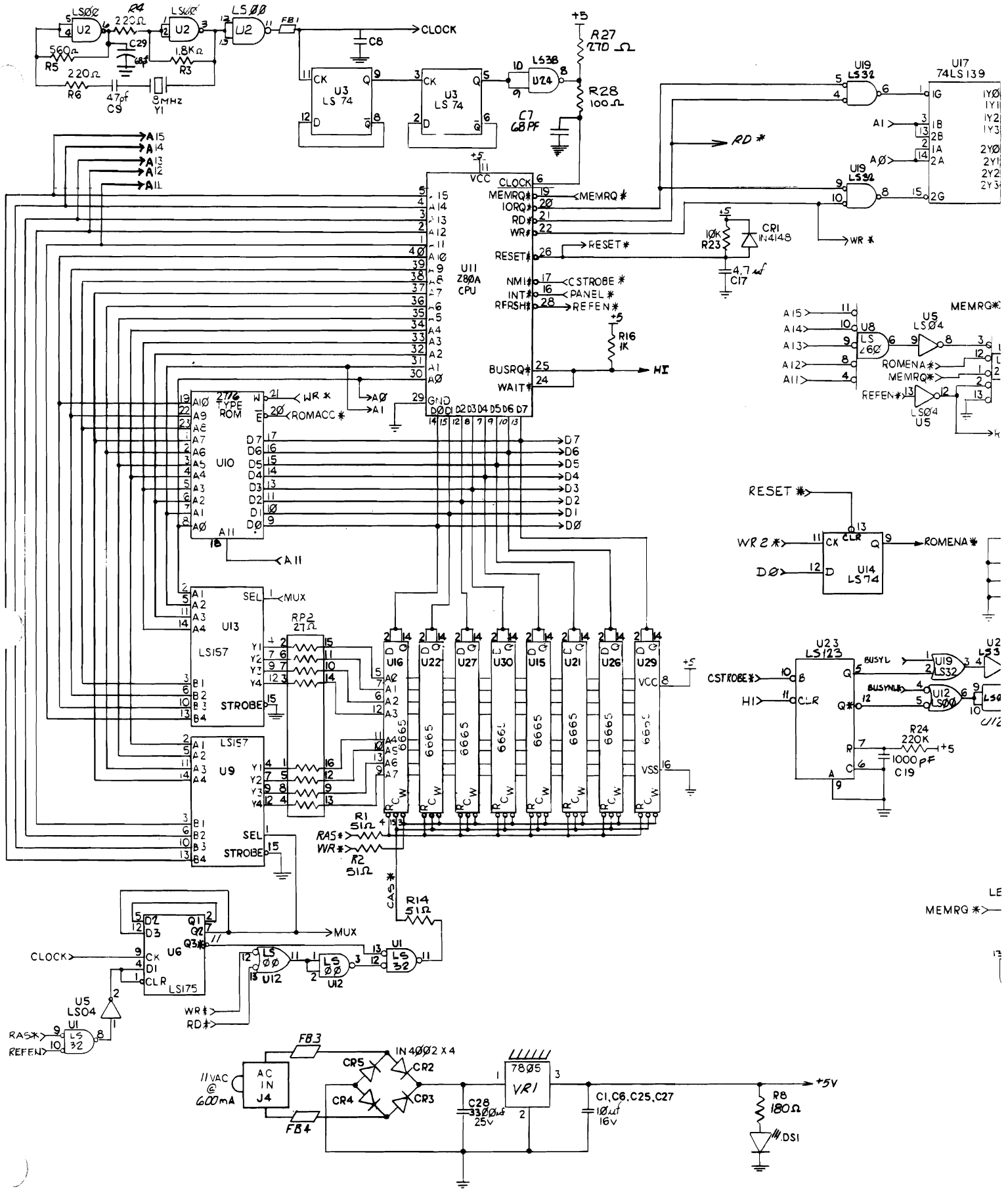
### 4.3.9 Front Panel Interrupts

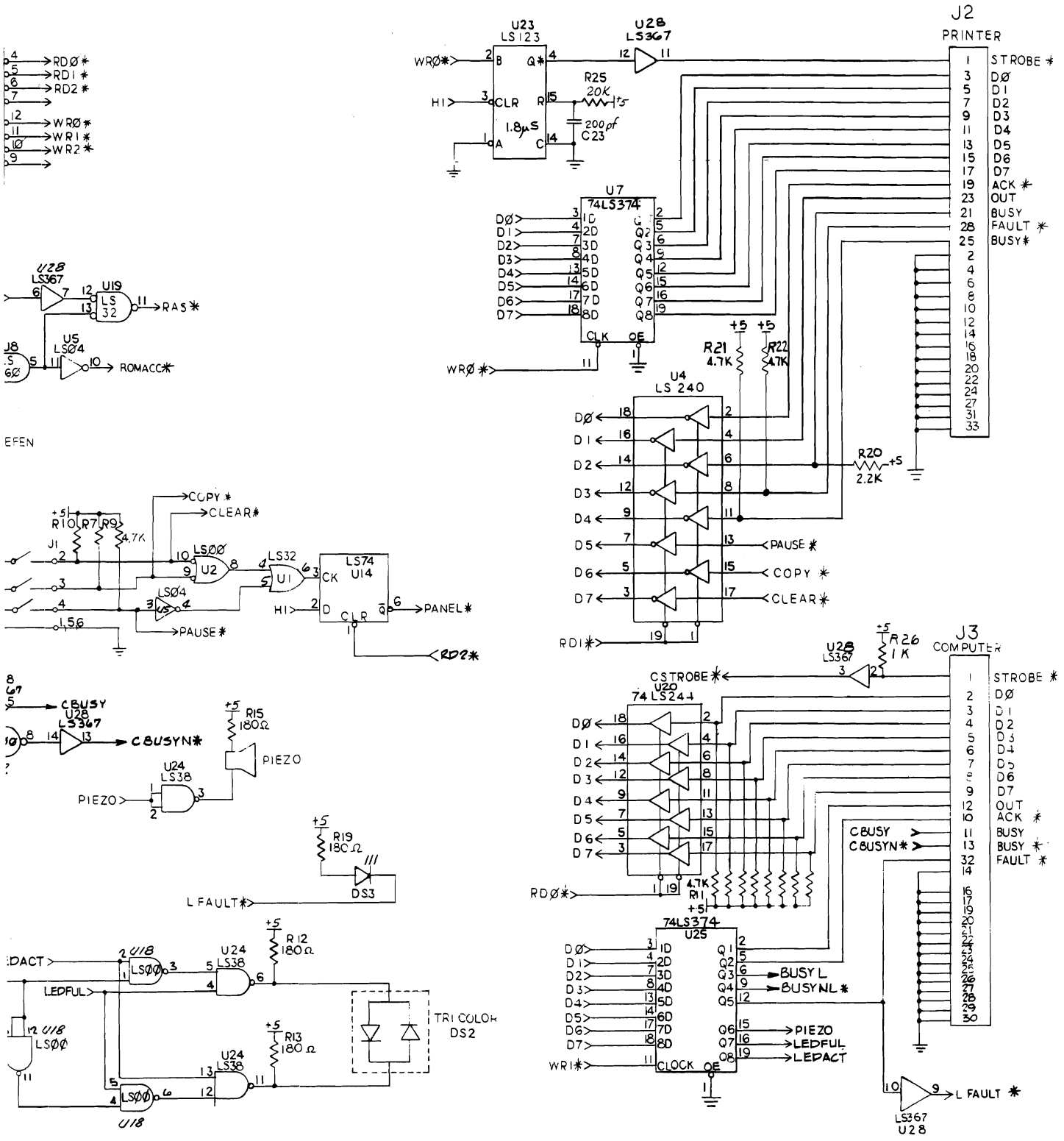
There are three keys on the front panel which are monitored by the processor. They are ORed together to generate a maskable interrupt (INT*) to the Z80 whenever a key is

pressed. To determine which key was pressed, the software reads the Printer Status port. The upper three bits represent the switch status. After processing these keys, the software executes an IN instruction from Port 2. This clears the LS74 latch (U14). This feature prevents keyboard bounce from generating multiple interrupts.

### 4.3.10 BUSY Generation

The BUSY and BUSY* signals are outputs of OR gates. The inputs to these OR gates are the output of the one-shot generated by outputting a byte of data to the printer port and the designated output bits on Port 1. This is necessary because of the Z80's clock speed. Since it is operating at 2 MHz, the clock cycle is 500 nS. BUSY must be generated within 50 nS of CSTROBE*. Therefore, the only means of meeting this specification is to generate BUSY in hardware. A one-shot generates a BUSY signal which is active for approximately 90 microseconds. During that period, the NMI service routine will turn on BUSY and BUSY* in Port 1. This will ensure that BUSY remains active until the byte is processed.


LS00
U2
R4
220Ω
LS00
U2
LS00
U2
FB1
CLOCK
560Ω
R5
220Ω
R6
C29
68pf
1.8KΩ
R3
47pf
C9
8MHz
Y1
C8
CK
Q
D
U3
LS 74
+5
R27
270 Ω
R28
100 Ω
C7
68 PF
LS38
U24
U19
LS32
U17
74LS139
RD *
WR *
A1
A0
1G
1B
2B
1A
2A
2G
1Y0
1Y1
1Y2
1Y3
2Y0
2Y1
2Y2
2Y3
VCC
CLOCK
MEMRQ*
IORQ*
RD*
WR*
RESET*
NMI*
INT*
RFRSH*
BUSRQ*
WAIT*
GND
U11
Z80A
CPU
CSTROBE *
PANEL *
REFEN*
HI
R16
1K
R23
10K
CR1
IN4148
4.7 uf
C17
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
D7
D6
D5
D4
D3
D2
D1
D0
2716
TYPE
ROM
U10
ROMACC *
A11
MEMRQ*
U5
LS04
U8
LS
260
ROMENA*
REFEN*
RESET *
WR2 *
U14
LS74
U13
LS157
SEL
MUX
STROBE
RP2
27Ω
U9
U16
U22
U27
U30
U15
U21
U26
U29
6665
VCC
VSS
R1
51Ω
R2
51Ω
RAS*
WR*
CAS*
R14
51Ω
U23
LS123
CSTROBE*
H1
CLR
BUSYL
BUSYNL
R24
220K
1000 PF
C19
U6
LS175
U1
LS32
U12
LS00
CLOCK
MUX
WR*
RD*
RAS*
REFEN*
FB3
FB4
AC
IN
J4
11VAC
@
600mA
IN4002 X 4
CR5
CR2
CR4
CR3
7805
VR1
C28
3300uf
25V
C1,C6,C25,C27
10uf
16V
+5V
R8
180Ω
LED1




**Schematic 8000177, Printer Controller 26-1269**

**Revision A**

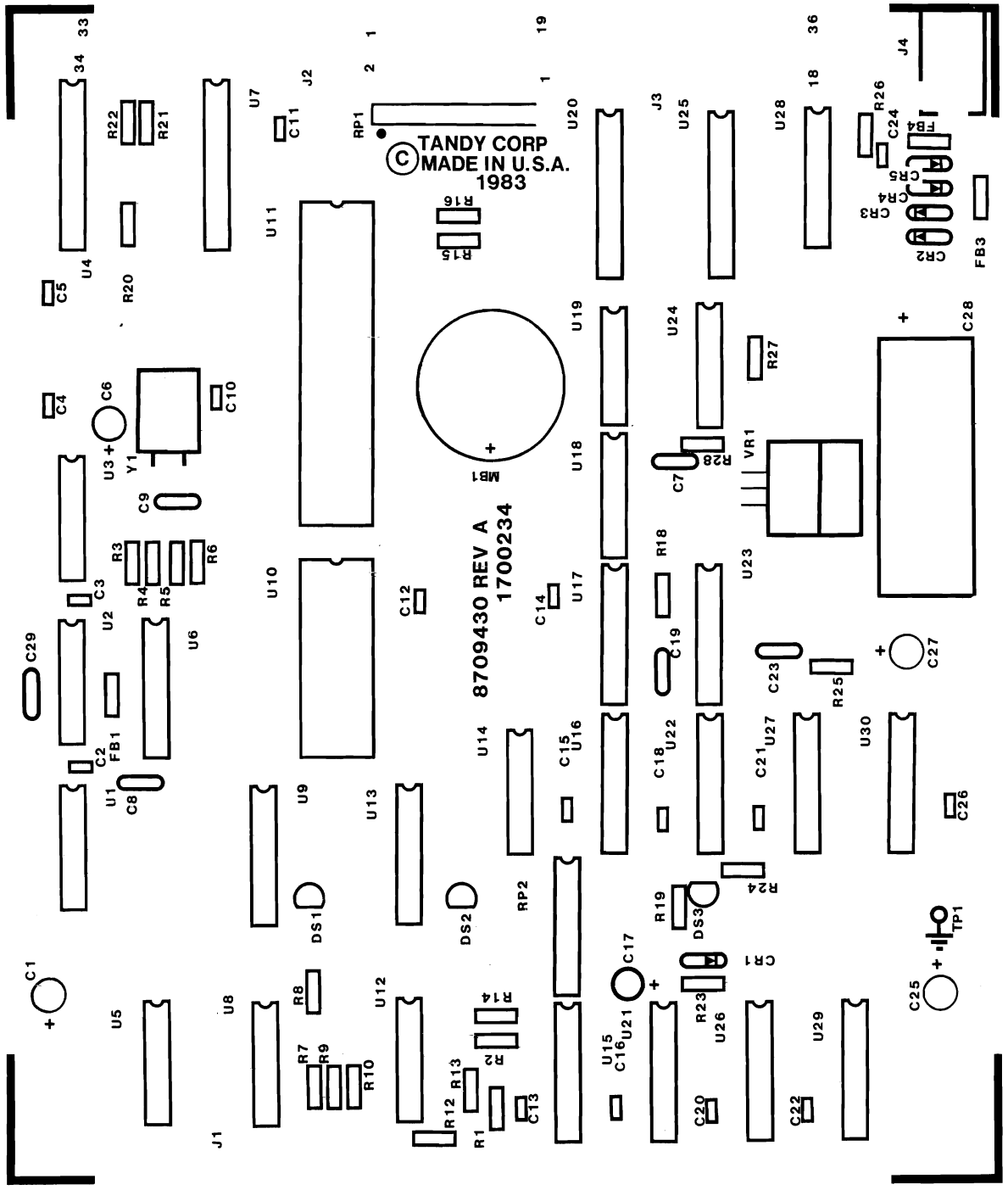



Figure 4-1. Component Layout, PCB Assembly 8851269
PTC-64 Printer Controller

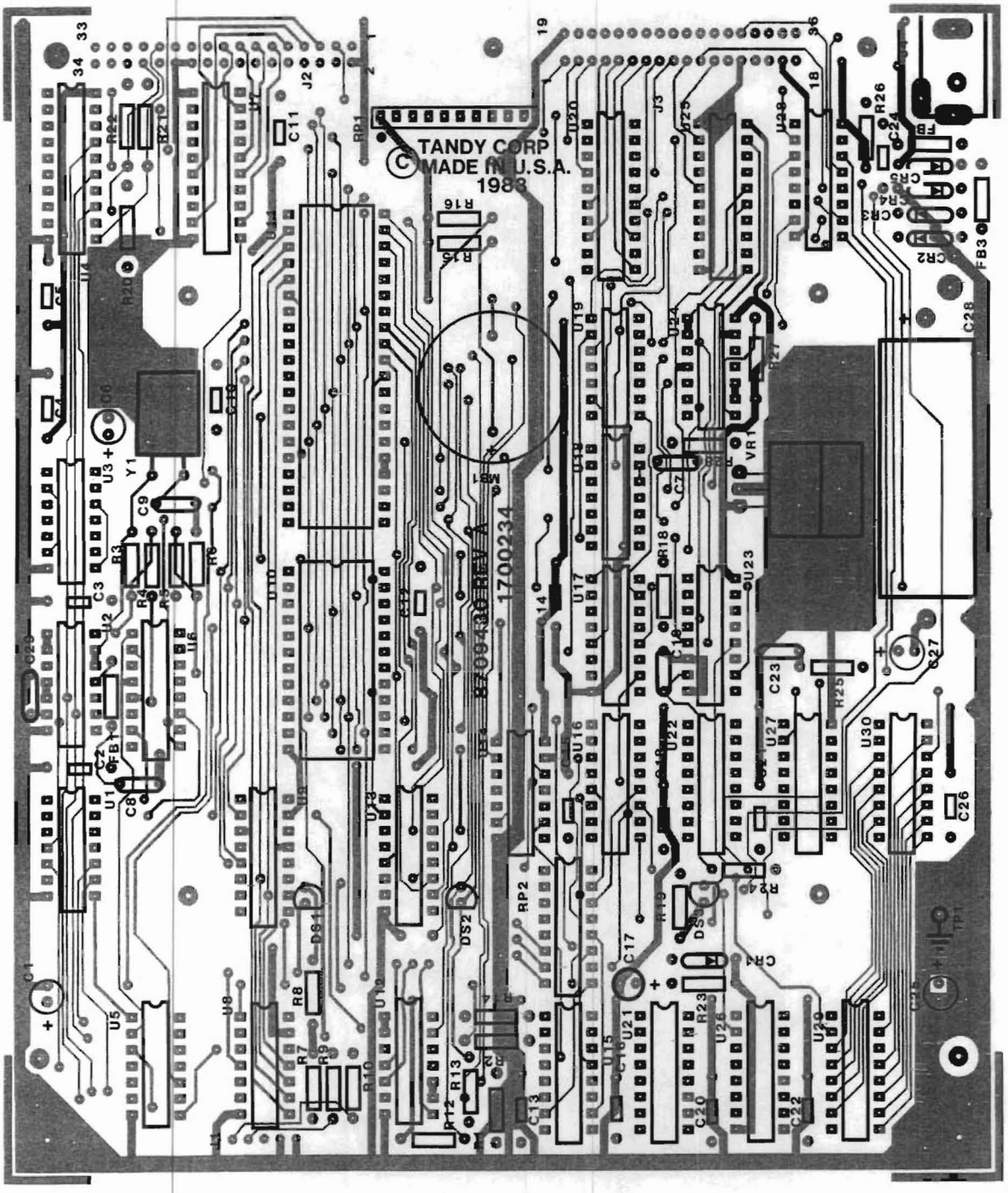



Figure 4-2. Circuit Trace, PCB Assembly 8851269
Component Side

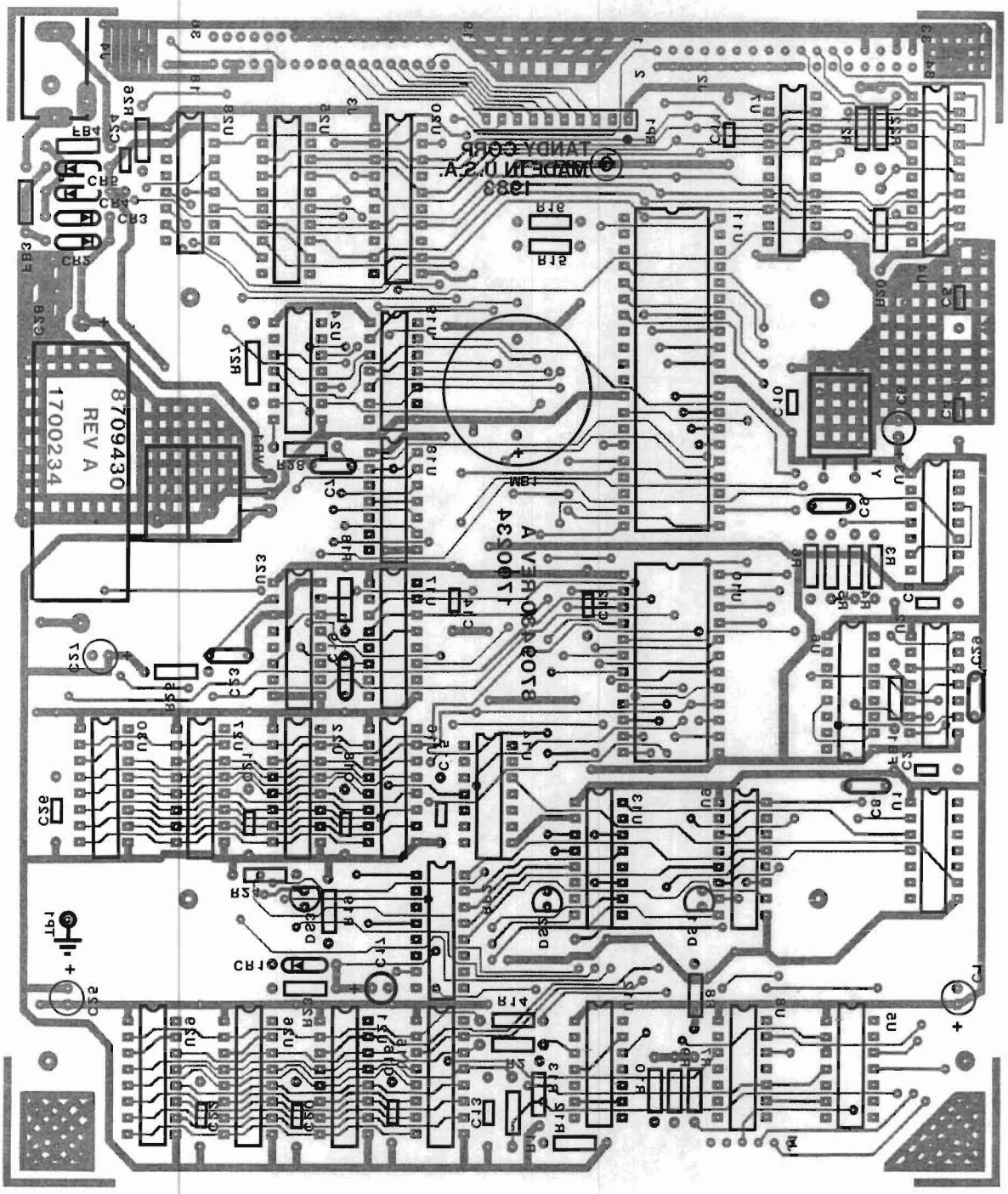



Figure 4-3. Circuit Trace, PCB Assembly 8851269
Solder Side

PARTS LIST, PCB ASSEMBLY 8851269, PTC-64 Assembly

| Item | Sym | Description | Mfg P/N |
|---|---|---|---|
| 1 | 1 | Printed Circuit Board | 8709430 |
| 2 | 1 | Connector, 6 Pos (J1) | 8519178 |
| 3 | 1 | Connector, 34-Pin Rt.Ang.(J2) | 8519179 |
| 4 | 1 | Connector, 36-Pin (J3) | 8519180 |
| 5 | 1 | Connector, Power In (J4) | 8519111 |
| 6 | 1 | Heat Sink, 6070B (VR1) | 8549011 |
| 7 | 1 | Heat Sink, 6071B (VR1) | 8549020 |
| 8 | 1 | Screw, #4-40 x 3/8 | 8569082 |
| 9 | 1 | Nut, #4 | 8579003 |
| 10 | 1 | Screw, #6-19 x 1/2 | 8569087 |
| 11 | 8 | Socket, 16-Pin DIP (U15,16, 21,22,26,27,29,30) | 8509003 |
| 12 | 1 | Socket, 24-Pin DIP (U10) | 8509001 |
| 13 | 1 | Socket, 40-Pin DIP (U11) | 8509002 |
| 14 | 1 | Staking Pin (TP1) | 8529014 |
| | C1 | Capacitor, 10 mfd, 16V Axial | 8316101 |
| | C2 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C3 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C4 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C5 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C6 | Capacitor, 10 mfd, 16V Axial | 8316101 |
| | C7 | Capacitor, 68 pfd, 50V Cer Disk | 8300684 |
| | C8 | Capacitor, 68 pfd, 50V Cer Disk | 8300684 |
| | C9 | Capacitor, 47 pfd, 50V Cer Disk | 8300472 |
| | C10 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C11 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C12 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C13 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C14 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C15 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C16 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C17 | Capacitor, 4.7 mfd, 10V Elec Rad | 8325470 |
| | C18 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C19 | Capacitor, 1000 pfd, 50V Cer Disk | 8302104 |
| | C20 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C21 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C22 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C23 | Capacitor, 200 pfd, 50V Cer Disk | 8301204 |
| | C24 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C25 | Capacitor, 10 mfd, 16V Axial | 8316101 |
| | C26 | Capacitor, 0.1 mfd, 50V Mono Axial | 8374104 |
| | C27 | Capacitor, 10 mfd, 16V Axial | 8316101 |
| | C28 | Capacitor, 4700 mfd, 16V Elec Axial | 8317474 |

PARTS LIST, PCB ASSEMBLY 8851269, PTC-64 Assembly

| Item | Sym | Description | Mfg P/N |
|---|---|---|---|
| | C29 | Capacitor, 68 pfd, 50V Cer Disk | 8300684 |
| | CR1 | Diode, 1N4148 | 8150148 |
| | CR2 | Diode, 1N4002 | 8150002 |
| | CR3 | Diode, 1N4002 | 8150002 |
| | CR4 | Diode, 1N4002 | 8150002 |
| | CR5 | Diode, 1N4002 | 8150002 |
| | DS1 | Diode, Light Emitting | 8469008 |
| | DS2 | Diode, Tri-Color Light Emitting | 8469013 |
| | DS3 | Diode, Light Emitting | 8469008 |
| | FB1 | Ferrite Bead | 8419014 |
| | FB2 | Not Used | |
| | FB3 | Ferrite Bead | 8419014 |
| | FB4 | Ferrite Bead | 8419014 |
| | MB1 | Buzzer, Piezo Electric | 8490004 |
| | R1 | Resistor, 51 ohm, 1/4W 5% | 8207056 |
| | R2 | Resistor, IC, 51 ohm, 1/4W 5% | 8207056 |
| | R3 | Resistor, 1.8K ohm, 1/4W 5% | 8207218 |
| | R4 | Resistor, 220 ohm, 1/4W 5% | 8207122 |
| | R5 | Resistor, 560 ohm, 1/4W 5% | 8207156 |
| | R6 | Resistor, 220 ohm, 1/4W 5% | 8207122 |
| | R7 | Resistor, IC, 4.7K ohm, 1/4W 5% | 8207247 |
| | R8 | Resistor, 180 ohm, 1/4W 5% | 8207118 |
| | R9 | Resistor, 4.7K ohm, 1/4W 5% | 8207247 |
| | R10 | Resistor, 4.7K ohm, 1/4W 5% | 8207247 |
| | R11 | Not Used | |
| | R12 | Resistor, 180 ohm, 1/4W 5% | 8207118 |
| | R13 | Resistor, 180 ohm, 1/4W 5% | 8207118 |
| | R14 | Resistor, 51 ohm, 1/4W 5% | 8207056 |
| | R15 | Resistor, 180 ohm, 1/4W 5% | 8207118 |
| | R16 | Resistor, 1K ohm, 1/4W 5% | 8207210 |
| | R17 | Resistor, 1K ohm, 1/4W 5% | 8207210 |
| | R18 | Resistor, 1K ohm, 1/4W 5% | 8207210 |
| | R19 | Resistor, 180 ohm, 1/4W 5% | 8207118 |
| | R20 | Resistor, 2.2K ohm, 1/4W 5% | 8207222 |
| | R21 | Resistor, 4.7K ohm, 1/4W 5% | 8207247 |
| | R22 | Resistor, 4.7K ohm, 1/4W 5% | 8207247 |
| | R23 | Resistor, 10K ohm, 1/4W 5% | 8207310 |

PARTS LIST, PCB ASSEMBLY 8851269, PTC-64 Assembly

| Item | Sym | Description | Mfg P/N |
|---|---|---|---|
| | R24 | Resistor, 220K ohm, 1/4W 5% | 8207422 |
| | R25 | Resistor, 20K ohm, 1/4W 5% | 8207320 |
| | R26 | Resistor, 1K ohm, 1/4W 5% | 8207210 |
| | R27 | Resistor, 150 ohm, 1/4W 5% | 8207115 |
| | R28 | Resistor, 100 ohm, 1/4W 5% | 8207110 |
| | RP1 | Resistor Pack, 4.7K ohm, 10-Pin | 8294247 |
| | RP2 | Resistor Pack, 27 ohm, 16-Pin DIP | 8290027 |
| | U1 | IC, 74LS32, Quad 2-In OR | 8020032 |
| | U2 | IC, 74LS00, Quad 2-In NAND | 8020000 |
| | U3 | IC, 74LS74, Dual Flip Flop | 8020074 |
| | U4 | IC, 74LS240, Octal Buffer | 8020240 |
| | U5 | IC, 74LS04, Hex Inverter | 8020004 |
| | U6 | IC, 74LS175, Quad Flip Flop | 8020175 |
| | U7 | IC, 74LS374, Octal Flip Flop | 8020374 |
| | U8 | IC, 74LS260, 5-In NOR | 8020260 |
| | U9 | IC, 74LS157, Multiplexer | 8020157 |
| | U10 | IC, EPROM 2716, 350ns | |
| | U11 | IC, Z80 CPU | 8047080 |
| | U12 | IC, 74LS00, Quad 2-In NAND | 8020000 |
| | U13 | IC, 74LS157, Multiplexer | 8020157 |
| | U14 | IC, 74LS74, Dual Flip Flop | 8020074 |
| | U15 | IC, 6665 RAM, 250 ns | 8040665 |
| | U16 | IC, 6665 RAM, 250 ns | 8040665 |
| | U17 | IC, 74LS139, Decoder | 8020139 |
| | U18 | IC, 74LS00, Quad 2-In NAND | 8020000 |
| | U19 | IC, 74LS32, Quad 2-In OR | 8020032 |
| | U20 | IC, 74LS244, Octal Buffer | 8020244 |
| | U21 | IC, 6665 RAM, 250 ns | 8040665 |
| | U22 | IC, 6665 RAM, 250 ns | 8040665 |
| | U23 | IC, 74LS123, Multivibrator | 8020123 |
| | U24 | IC, 74LS38, Quad 2-In NAND | 8020038 |
| | U25 | IC, 74LS374, Octal Flip Flop | 8020374 |
| | U26 | IC, 6665 RAM, 250 ns | 8040665 |
| | U27 | IC, 6665 RAM, 250 ns | 8040665 |
| | U28 | IC, 74LS367, Hex Bus Driver | 8020367 |
| | U29 | IC, 6665 RAM, 250 ns | 8040665 |
| | U30 | IC, 6665 RAM, 250 ns | 8040665 |
| | VR1 | Voltage Regulator, 7805 +5V | 8050805 |
| | Y1 | Crystal, 8 MHz | 8409006 |

# 5/ CONNECTOR PIN OUT DESCRIPTIONS

## 5.1 Parallel Interface Signals and Levels

The 34-pin connector (J2) on the back of the PTC-64 is a prallel interface for connection to a line printer. Eight data bits are output in parallel, and five input data bits are status indicators. All levels are TTL compatible.

The connector pin-outs and signals available are listed on the next page.

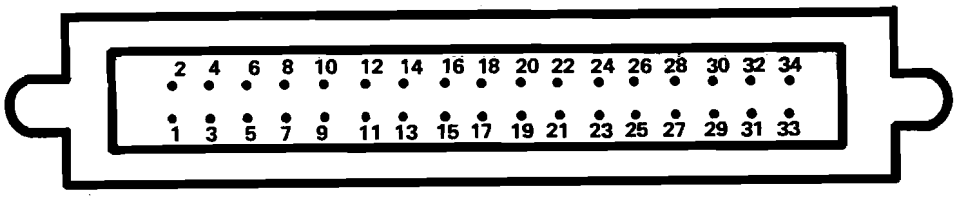



Figure 5-1. J2 Pin Arrangement

| Signal | Function | Pin # |
|---|---|---|
| STROBE* | 1.8µs pulse to clock the data from PTC-64 to printer | 1 |
| DATA 0 | Bit 0 (lsb) of output data byte | 3 |
| DATA 1 | Bit 1 of output data byte | 5 |
| DATA 2 | Bit 2 of output data byte | 7 |
| DATA 3 | Bit 3 of output data byte | 9 |
| DATA 4 | Bit 4 of output data byte | 11 |
| DATA 5 | Bit 5 of output data byte | 13 |
| DATA 6 | Bit 6 of output data byte | 15 |
| DATA 7 | Bit 7 (msb) of output data byte | 17 |
| ACK* | Input to PTC-64 from Printer, low pulse indicates data byte received | 19 |
| BUSY | Input to PTC-64 from Printer, high indicates busy | 21 |
| OUT | Input to PTC-64 from Printer, high indicates no paper - if Printer doesn't provide this, signal is forced low | 23 |
| BUSY* | Input to PTC-64 from Printer, logical inverse of BUSY | 25 |
| FAULT* | Input to PTC-64 from Printer low indicates fault (paper empty, light detect, deselect, etc.) | 28 |
| GROUND | Common signal ground | 2,4,6,8 10,12, 14,16, 18,20, 22,24, 27,31 33 |
| NC | Not connected | 29,30 32,34 |

*These signals are active-low.

## 5.2 Parallel Interface

A 36-pin plastic female connector (J3) on the left rear of the PCT-64 allows connection to a computer.

The pin arragement of the connector, signal summary, and the interface timing are shown below.

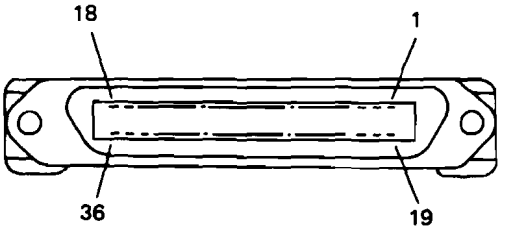



Figure 5-2. J3 Pin Arrangement

| Signal Pin | Return Pin | Name of Signals |
|---|---|---|
| 1 | 19 | STROBE* |
| 2 | 20 | DATA 0 |
| 3 | 21 | DATA 1 |
| 4 | 22 | DATA 2 |
| 5 | 23 | DATA 3 |
| 6 | 24 | DATA 4 |
| 7 | 25 | DATA 5 |
| 8 | 26 | DATA 6 |
| 9 | 27 | DATA 7 |
| 10 | 28 | ACK* |
| 11 | 29 | BUSY |
| 12 | -- | OUT (Paper Out) |
| 13 | -- | BUSY* |
| 14 | -- | OV |
| 15 | -- | NC |
| 16 | -- | OV |
| 17 | -- | CHASSIS GROUND |
| 18 | -- | 5V (80mA Maximum) |
| 30 | -- | OV |
| 31 | -- | NC |
| 32 | -- | FAULT* (Printer Error Condition) |
| 33 | -- | NC |
| 34 | -- | NC |
| 35 | -- | NC |
| 36 | -- | NC |

# 6/ TROUBLESHOOTING

## 6.1 Isolate the Problem

If the PTC-64 is not operating, check the Power Supply circuit first. Watch the POWER LED on the front panel; when unit is turned ON, the LED lights. If the LED does not light, turn to Paragraph 6.2. If it does light, ask yourself the following questions.

1) Does the beeper sound when you press any key?

2) Does the PTC-64 perform a RAM test? (FAULT LED lights upon power-up.)

If you answered "no" to either question, go to Paragraph 6.3. If you answered "yes", continue.

3) Does the PTC-64 pass the RAM test? If not, go to Paragraph 6.4.

4) Is the message sent correctly to the printer when the Self-Test is performed? If not, go to Paragraph 6.5.

If you answered "yes" to the above questions, but the PTC-64 will not accept correct data from the computer, see Paragraph 6.6.

## 6.2 Power Supply

Verify that the AC adapter is providing the right AC voltage. The output voltage should be between 11 and 18 volts AC when measured with a DVM. If the AC adapter is working correctly, plug it into the PTC-64 and measure the DC voltage at Pin 1 of VR1 (7805). This input voltage should be at least 7 VDC. If not, replace CR2 - CR5. Measure the output at pin 3; it should be 5 VDC +/- 0.25V. If the output voltage is out of range, replace VR1. Once you have verified that you have a +5 VDC supply, make sure that DS1 (POWER LED) is functioning. If not, replace DS1.

## 6.3 Processor

The Z-80 microprocessor (U11) depends on many other circuits for proper operation. The first and foremost of these is the clock circuit. Since the Theory of Operation (Section 4) describes all of these circuits, we will simply verify that the clock is working. Put a probe on U3 pin 11 (LS74). This should be an 8 MHz clock (125 ns period). If this is not present, U2 or Y1 is probably bad. Refer to Section 4. If the clock is present, measure U3 pin 5. This should show a 2 MHz clock (500 nS period). If it doesn't, replace U3. If the clock is present, verify that it also exists at pin 6 of U11.

After you have verified that the clock is working correctly, check U11 pin 11 for +5 V. If that voltage is not present, go to section 5.2 Power Supply. If the power supply is working correctly, check pin 26 of U11, the RESET* signal. If this is low, replace the components shown on the schematic for Power On Reset.

Those are the only signals that could prevent the microprocessor from working. If you have found no other solution, replace U11. If the PTC-64 still does not operate correctly, replace the ROM and check the address decoding circuitry. Refer to Section 4.

If the microprocessor is working, but will not recognize any of the keys from the front panel, the interrupt circuitry is not working. There are only two possible reasons that interrupts would not work. Either the keyboard is not working (or not plugged in), or U14, 74LS74, is faulty.

Look at pin 3 of U14 (LS74). It should toggle from ground to +5V when a key is pressed. If it does not then replace the keyboard, otherwise, check pin 6 of U14. It should go to ground when the key is pressed. This signal should also go to pin 16 of U11. If it is not present, replace U14.

If you are getting interrupts, but the PTC-64 is not performing the specified function, it is possible that the proper key is not being returned. Check the inputs to U4 (pins 3,5,7,9,12,14,16,18). If these inputs are toggling, replace U4.

## 6.4 RAM Replacement

When there is a RAM error, a message is printed that indicates where the error occurred. It will look something like this:

Buffer memory error...Wrote,Read : 55,57

The first number (5) is the hex value written to memory, and the second value (57) is what was read back. The PTC-64 only writes out a 55 and then AA to check all memory bits.

If you get a RAM error message, look at the table below to see wheck RAMs need replaceing. If you still get a memory error after replaceing the RAMs, then refer to Section 4 for memory timing description and check-out.

**Value Written:** 55

| **Value Read** | **Suspect Parts** | | |
|---|---|---|---|
| First Digit: | | Second Digit: | |
| 0 | U15,26 | 0 | U16,27 |
| 1 | U26 | 1 | U27 |
| 2 | U15,21,26 | 2 | U16,22,27 |
| 3 | U21,26 | 3 | U22,27 |
| 4 | U15 | 4 | U16 |
| 6 | U15,21 | 6 | U16,22 |
| 7 | U21 | 7 | U22 |
| 8 | U15,26,29 | 8 | U16,27,30 |
| 9 | U26,29 | 9 | U27,30 |
| A | U15,21,26,29 | A | U16,22,27,30 |
| B | U21,26,29 | B | U22,27,30 |
| C | U15,29 | C | U16,30 |
| D | U29 | D | U30 |
| E | U15,21,29 | E | U16,22,30 |
| F | U21,29 | F | U22,30 |

**Value Written: AA**

| Value Read | Suspect Parts | | |
|---|---|---|---|
| First Digit: | | Second Digit: | |
| 0 | U21,29 | 0 | U22,30 |
| 1 | U15,21,29 | 1 | U16,22,30 |
| 2 | U29 | 2 | U30 |
| 3 | U15,29 | 3 | U16,30 |
| 4 | U15,26,29 | 4 | U16,27,30 |
| 5 | U15,21,26,29 | 5 | U16,22,27,30 |
| 6 | U26,29 | 6 | U27,30 |
| 7 | U15,26,29 | 7 | U16,27,30 |
| 8 | U21 | 8 | U22 |
| 9 | U15,21 | 9 | U16,22 |
| B | U15 | B | U16 |
| C | U21,26 | C | U22,27 |
| D | U15,21,26 | C | U16,22,27 |
| E | U26 | E | U27 |
| F | U15,26 | F | U16,27 |

## 6.5 Printer Port

If data is accepted by the PTC-64, but is not printed or not printed correctly, there could be a fault with the Printer Port. The first step is to isolate the problem.

Disconnect the PTC-64 and connect the computer directly to the printer. If the printer is functional, the problem is in the PTC-64. If it is not functional, either your printer is bad or you have a defective cable.

If the PTC-64 is the problem, execute the Self-Test (press the CLEAR and PAUSE keys together) to be sure that the problem is with the Printer Port rather than the Computer Port. At the end of the test, a message will be printed. If it is not printed, or printed incorrectly, proceed with the Printer Port troubleshooting, otherwise, check the Computer Port.

If invalid data is printed, the data latch probably has a stuck bit. Replacing U7 (74LS374) should correct this problem. If no data at all is printed, check pin 4 of U23.

It should generate a 1.8 µs signal. If you have no signal, replace U23. If the pulse is too short, replace R25 and C23.

There is one other condition that could keep the printer from working. If the PTC-64 could not read good status from the printer, then it would never transmit data, U4 (LS240) is the status register from the printer. Make sure that the proper status is getting to the inputs of that register.

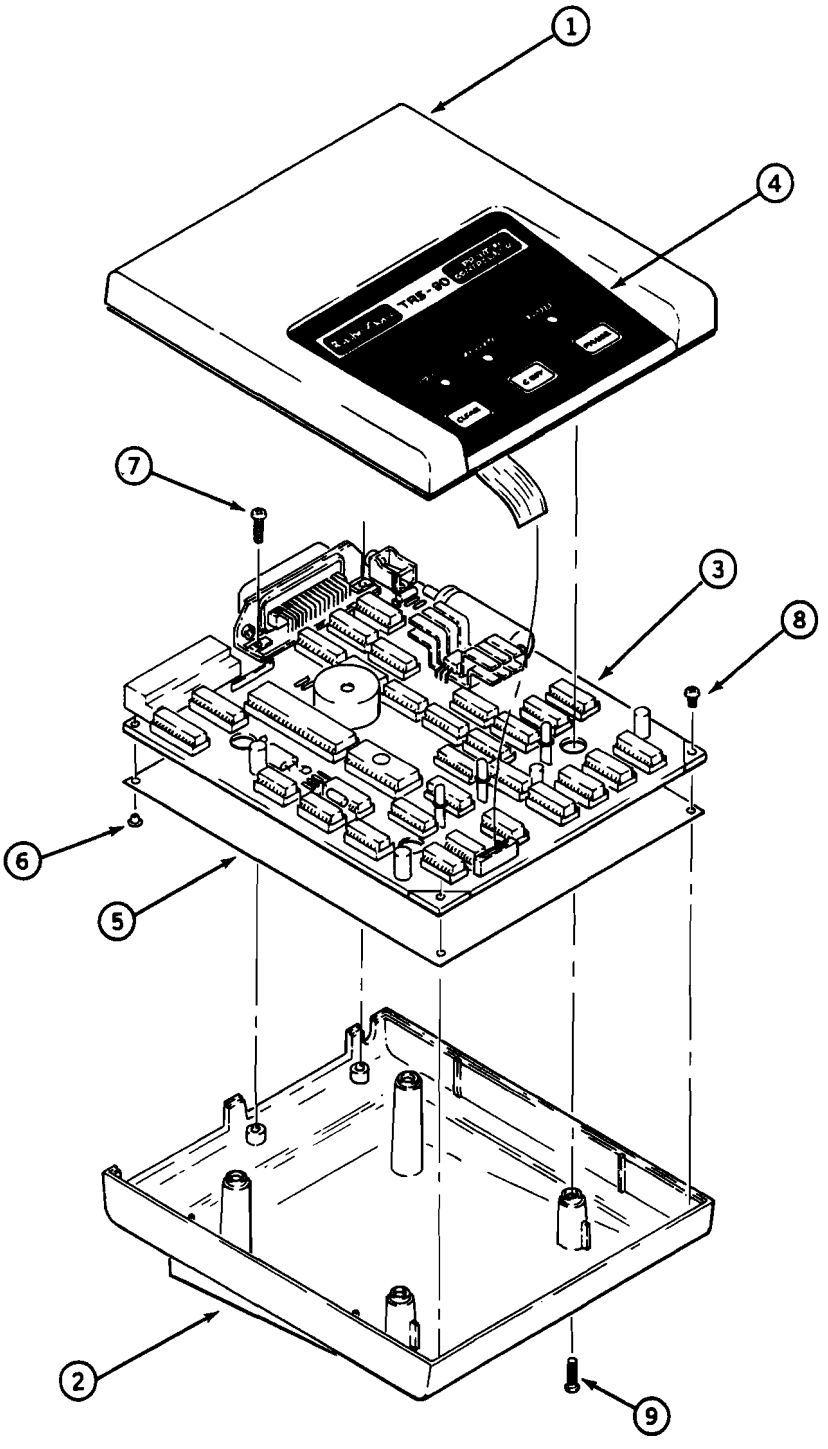
## 6.6 Computer Port

When the computer has data to transfer to the PTC-64, it first checks the status. If the PTC-64 does not provide good status (not busy, no fault), the computer will not transmit the data.

If no data will print, see if the FAULT LED is lit. If it is, there is a printer fault and the Printer Controller will not accept data. Correct the printer problem.

If the data is being transmitted, yet invalid data being printed, the problem is probably in the data register. Replace U20 (LS244) and begin the troubleshooting tests again.

If no data is being transmitted, (look at STATUS LED), then the STROBE from the computer is not getting to U11. Check U28 pin 3 for an active low pulse. If the pulse is not present, replace U28. One other potential fault could be the computer cable itself. Since STROBE is on pin 1, it is the outside wire of the flat cable and could have problems with intermittent connection. Try replacing the cable.




Exploded View, PTC-64

## 7/ EXPLODED VIEW WITH PARTS LIST

Printer Controller PTC-64

| Ref | Qty | Description | Mfg P/N |
|---|---|---|---|
| 1 | 1 | Case, Top | 8719325 |
| 2 | 1 | Case, Bottom | 8719326 |
| 3 | 1 | PCB Assembly | 8851269 |
| 4 | 1 | Membrane Keyboard/Overlay | 8790532 |
| 5 | 1 | Shield, PCB | 8729264 |
| 6 | 2 | Trimounts (PCB to Shield) | 8559033 |
| 7 | 2 | Screw, #4 x 3/8" (connector mount) | 8569102 |
| 8 | 2 | Screw, #4 x 1/4" (PCB mount) | 8569032 |
| 9 | 4 | Screw, #6-19 x 1/2" PPH | 8569087 |

MISCELLANEOUS

| | | | |
|---|---|---|---|
| | 1 | AC Adapter, External | 8790053 |
| | 1 | Label, Serial | 87891004 |
| | 1 | Label, Backpanel | 87891013 |

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